Massachusetts Institute of Technology
Department of Physics
8.022 Fall 2004
Assignment 7: Faraday's law; Inductance
Due date: Friday, Nov 5th

1. Faraday's Law.

   A long solenoid, of radius a, is driven by an alternating current, so that the field inside is sinusoidal: $\vec{B}(t) = B_0 cos(\omega t)\hat{z}$. A circular loop of wire, of radius $a/2$ and resistance R, is placed inside the solenoid, and coaxial with it. Find the current induced in the loop, as a functioin of time.

2. Purcell 7.11 Mutual and self induction of coils.

3. Purcell 7.14 A metal crossbar in the magnetic field.

4. Purcell 7.17 LR circuits.

5. Purcell 7.21 Mutual inductance of coaxial solenoids.

6. Purcell 7.22 Angular momentum and electromagnetic fields.

7. Toroidal coil.

   Using two approaches to find the self-induction of a toroidal coil with rectangular cross section (inner radius a, outer radius b, height h), which carries a total of N turns.

8. Second Derivatives.

   Prove the identity:

$$\bigtriangledown \times (\bigtriangledown \times \mathbf{A}) = \bigtriangledown(\bigtriangledown \cdot \mathbf{A}) - \bigtriangledown^{\mathbf{2}}\mathbf{A} \tag{1}$$